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Kim et al.

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(54) **ANKLE MUSCLE RESISTANCE-TRAINING APPARATUS**

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A63B 21/005 (2006.01)
A63B 22/06 (2006.01)

(52) **U.S. Cl.**
CPC ***A63B 23/08*** (2013.01); ***A63B 21/0056*** (2013.01); ***A63B 22/0605*** (2013.01); *A63B 2022/0611* (2013.01)

(58) **Field of Classification Search**
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(Continued)

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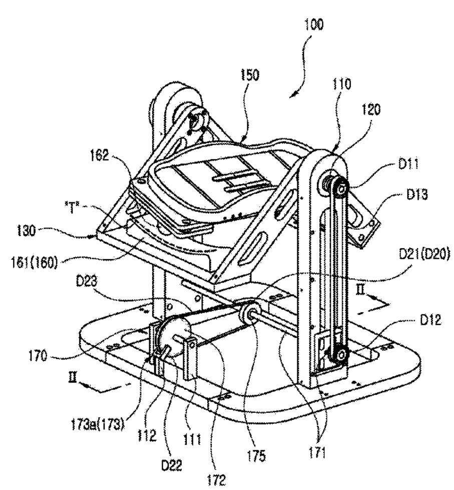
(57) **ABSTRACT**

The present invention addresses the technical problem of providing an ankle muscle resistance-training apparatus which induces an angle change of the ankle while the ankle is actively moving, and can improve strength of the ankle muscle by applying resistance force to the ankle movement. To this end, the ankle muscle resistance-training apparatus according to the present invention comprises: a support member; a first movement guiding shaft; an intermediate member; a second movement guiding shaft; a foot support; a first resistance force application part; and a second resistance force application part. The first resistance force application part is linked with the first movement guiding shaft and applies resistance force of an adjustable intensity against the active ankle movement of a user made with respect to the first movement guiding shaft in a state in which the foot is placed on the foot support, and the second resistance force application part is linked with the second movement guiding shaft and applies resistance force of an adjustable intensity against the active ankle movement of a user made with
(Continued)



respect to the second movement guiding shaft in the state in which the foot is placed on the foot support.

6 Claims, 7 Drawing Sheets

(58) **Field of Classification Search**
CPC A63B 2026/006; A63B 2209/00; A63B 2209/08; A63B 21/4047; A63B 21/4049; A63B 21/005; A63B 21/0051; A63B 21/0052; A63B 21/015; A61H 1/02; A61H 1/0214; A61H 2001/0207; A61H 1/0237; A61H 1/0266; A61H 2201/1261; A61H 2201/1207; A61H 2201/1436
See application file for complete search history.

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FIG. 1

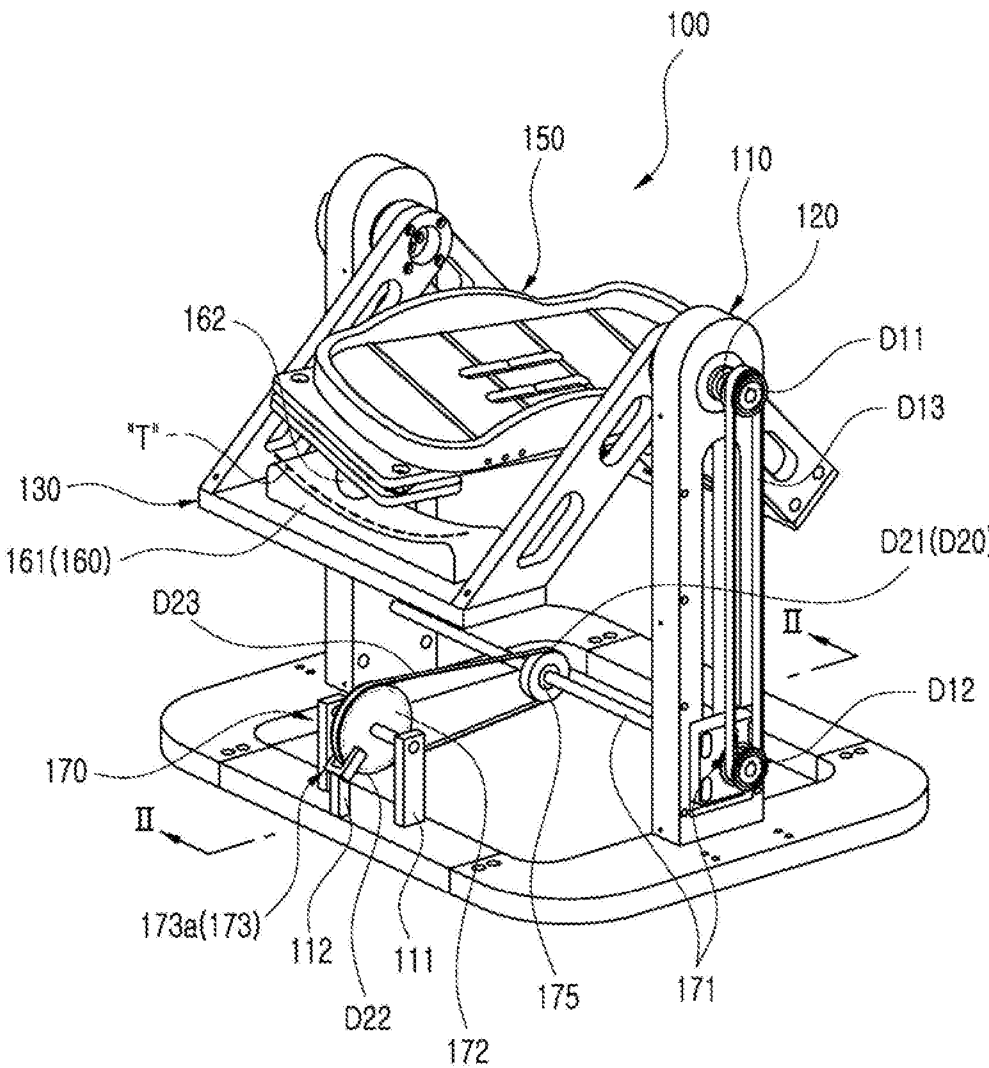

100
150
110
120
162
D11
D13
"T"
130
161(160)
D21(D20)
D23
II
D12
170
II
173a(173)
112
111
D22
172
175
171

FIG. 2

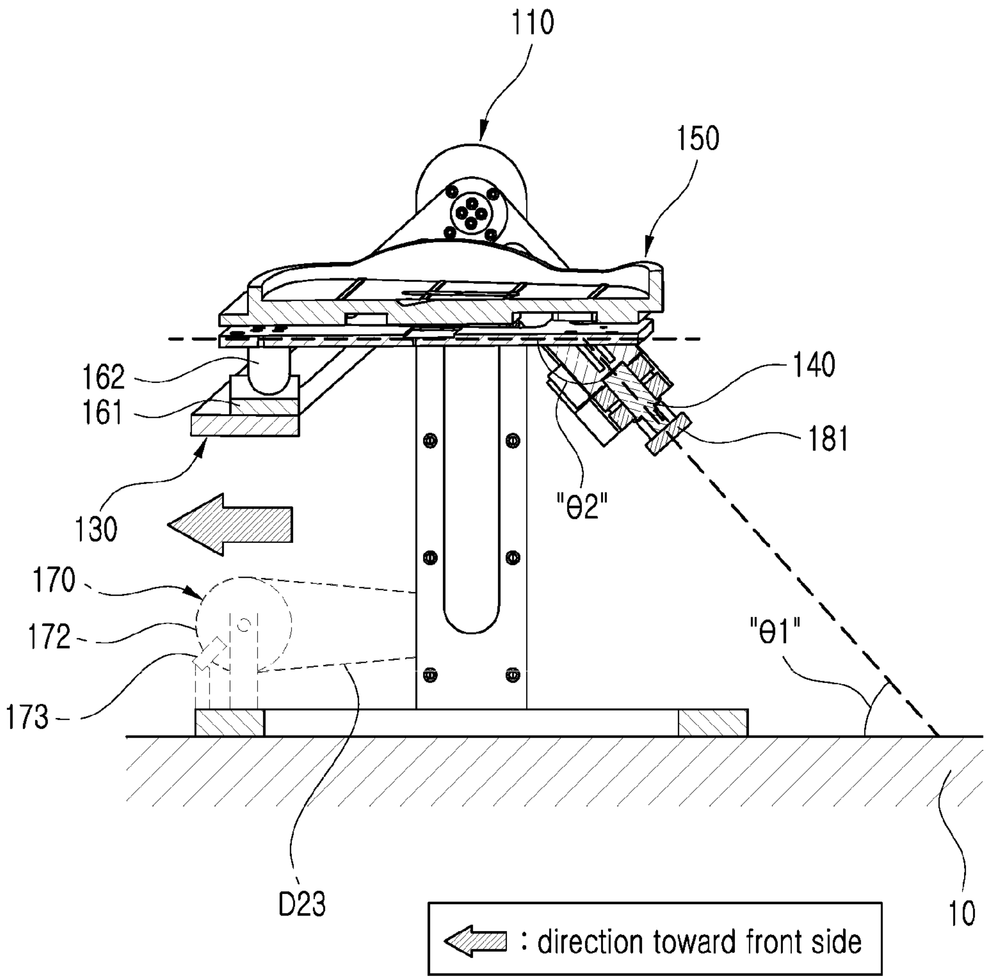
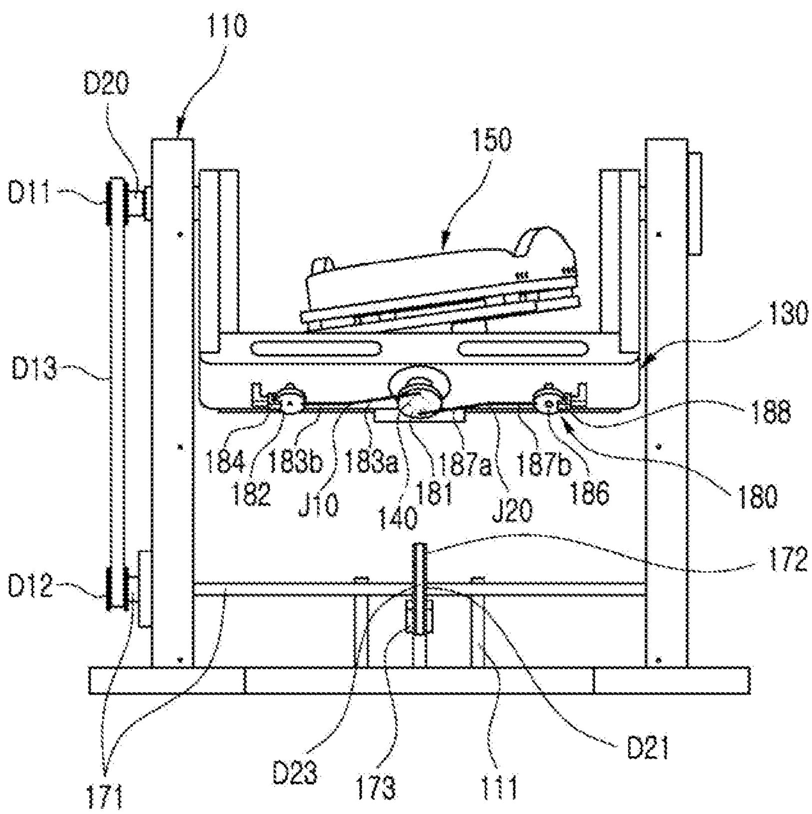

110
150
162
161
140
181
"θ2"
130
170
172
"θ1"
173
D23
10
: direction toward front side

FIG. 3



110
D20
D11
150
130
D13
188
184
183b
183a
187a
187b
182
J10
181
J20
186
180
140
172
D12
171
D23
173
111
D21

FIG. 4

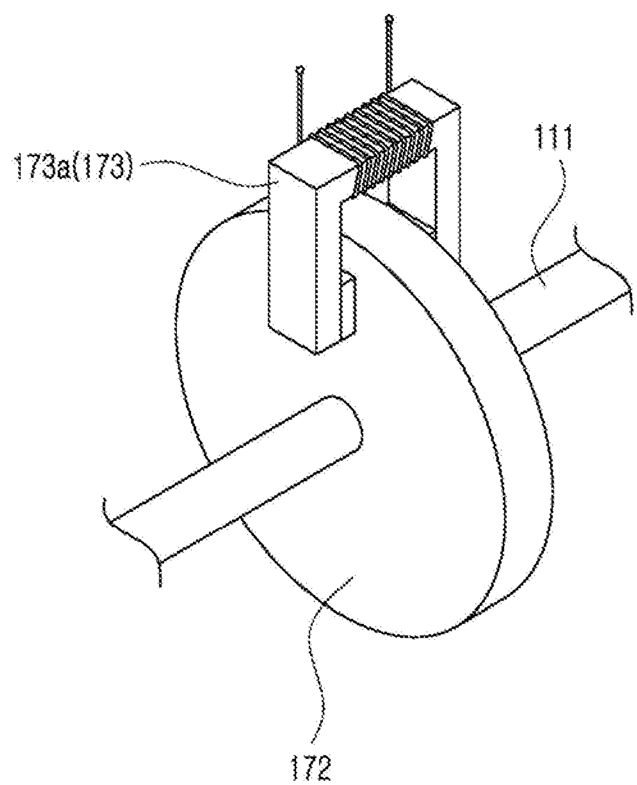


FIG. 5

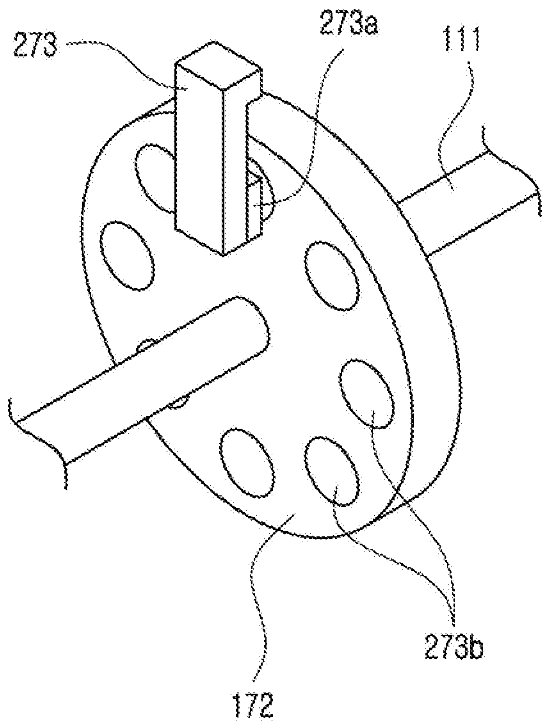

273
273a
111
172
273b

FIG. 6

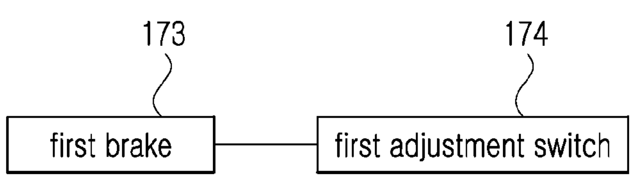
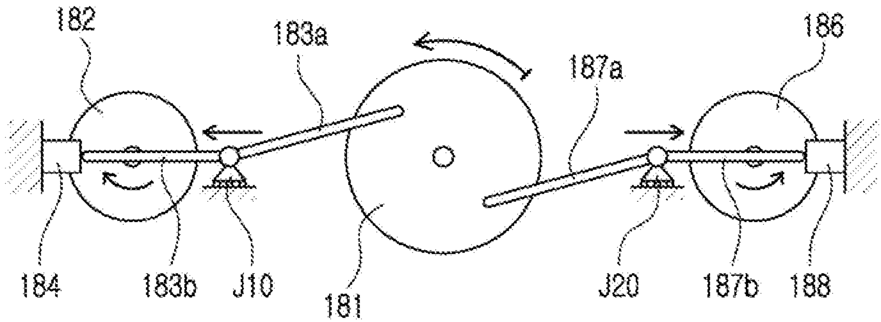
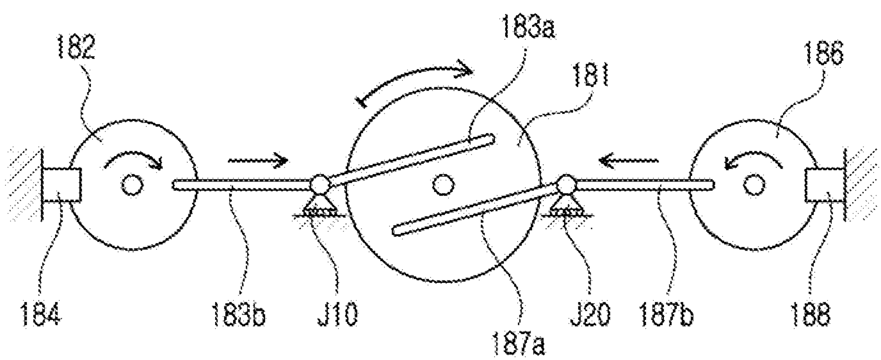

173
174
first brake
first adjustment switch

FIG. 7

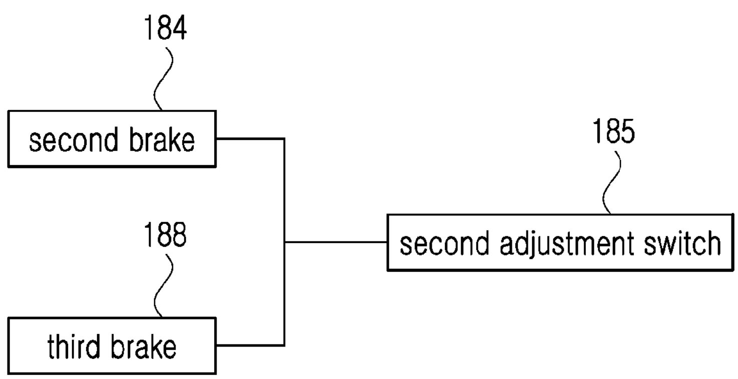

182
183a
187a
186
184
183b
J10
181
J20
187b
188

(a)


183a
182
181
186
184
183b
J10
187a
J20
187b
188

(b)

FIG. 8


184
second brake
188
third brake
185
second adjustment switch

ANKLE MUSCLE RESISTANCE-TRAINING APPARATUS

TECHNICAL FIELD

The present disclosure relates to an ankle muscle resistance-training apparatus.

BACKGROUND ART

In general, ankle movement, along with the muscle strength, has an important effect on gait stability. The ankle movements can be summarized as movements occurring in the sagittal plane, the frontal plane, and the transverse plane, and occurs according to the movements of the ankle joint (or talocrural joint), transverse tarsal joint, and subtalar joint.

Damage, impairment, and loss of lower extremity function due to musculoskeletal and central nervous system diseases may lead to a decrease in gait ability or loss, which can be regarded as one of the serious causes of hindering the performance of independent daily living. In particular, in the case of stroke, which is one of the central nervous system diseases, most patients support 61% to 80% of the total body weight with a non-injured lower limb, thus exhibiting asymmetric posture alignment and deterioration of balance ability. Abnormal gait patterns after the stroke include stiff-knee gait during the swing phase, genu recuvatum during the stance phase, reduction of dorsiflexion at the stance phase and excessive plantar flexion during the swing phase, and the like. In addition, gait speed, cadence, and stride length are reduced, and double stance periods are increased, and the standing period of the damaged side is shorter than that of the non-injured side.

Therefore, for the gait rehabilitation of people with central nervous system disorders such as stroke, functional electric stimulation, brace support, and the like are applied, or methods of performing joint movement range exercises by the therapist, stretching exercises, resistance bands, manual ankle trainers, weight-bearing resistance exercises in an upright posture, and so on are clinically used. Furthermore, in order to provide a range of movement of the ankle, an automatic ankle trainer is also used, which includes a rotation shaft corresponding to the ankle joint and driven by a motor. These gait training interventions involving ankles have positive effects such as increased gait stability, gait speed, gait efficiency, and so on.

However, these methods have limitations in improving muscle strength because by these methods, a disabled user with hemiplegia is not allowed to actively move his or her ankle, but is passively provided with a range of movements of the ankle by the therapist, trainer, and the like, and accordingly does not have a resistance force during ankle movement.

DETAILED DESCRIPTION OF THE INVENTION

Technical Problem

The technical problem of the present disclosure is to provide an ankle muscle resistance-training apparatus capable of improving ankle muscle strength by inducing an angle change of an ankle, and also by applying a resistance force to a movement of the ankle during active movement of the ankle.

Technical Solution

In order to achieve the objects described above, an ankle muscle resistance-training apparatus according to an

embodiment of the present disclosure is provided, which may include: a support member; a first movement guiding shaft perpendicular to a front-rear direction of the support member and horizontal to a ground; an intermediate member rotatably provided on the support member with respect to the first movement guiding shaft; a second movement guiding shaft perpendicular to the first movement guiding shaft and inclined to the ground; a foot support rotatably provided on the intermediate member with respect to the second movement guiding shaft and inclined with respect to the second movement guiding shaft, and on which a foot of a user is placed; a first resistance force application part linked with the first movement guiding shaft and applying resistance force of an adjustable intensity against the active ankle movement of the user made with respect to the first movement guiding shaft in a state in which the foot is placed on the foot support; and a second resistance force application part linked with the second movement guiding shaft and applying resistance force of an adjustable intensity against the active ankle movement of the user made with respect to the second movement guiding shaft in a state in which the foot is placed on the foot support.

The first resistance force application part may include: a link shaft provided rotatably on the support member and linked with the first movement guiding shaft; a rotating disk provided rotatably on the support member through a first support bracket and linked with the first link shaft; a first brake applying a braking force to the rotating disk using an electromagnet; and a first adjustment switch for adjusting a strength of the electromagnet of the first brake.

The first resistance force application part may further include an one-way bearing supporting any one of the first movement guiding shaft, the link shaft, and the rotating disk such that the resistance force is applied only when the foot support is pressed by an ankle of the user.

The second resistance force application part may include: a center crank wheel linked with the second movement guiding shaft; a first side crank wheel spaced apart from one side of the center crank wheel and rotatably provided on one side of the intermediate member; a first horizontal sliding joint slidably provided on the intermediate member to be slid left and right between the center crank wheel and the first side crank wheel; a first crank arm linking the center crank wheel with the first horizontal sliding joint; a second crank arm linking the first horizontal sliding joint and the first side crank wheel; a second brake applying braking force to the first side crank wheel using an electromagnet; and a second adjustment switch for adjusting a strength of the second brake.

The second resistance force application part may further include: a second side crank wheel spaced apart from the other side of the center crank wheel and rotatably provided on the other side of the intermediate member; a second horizontal sliding joint slidably provided on the intermediate member to be slid left and right between the center crank wheel and the second side crank wheel; a third crank arm linking the center crank wheel with the second horizontal sliding joint; a fourth crank arm linking the second horizontal sliding joint with the second side crank wheel; and a third brake applying a braking force to the second side crank wheel using an electromagnet, in which the second adjustment switch may adjust the strengths of the electromagnets of the second and third brakes together.

The first movement guiding shaft may be provided such that an ankle joint of the user is placed in an axial direction thereof.

The second movement guiding shaft may be provided such that a subtalar joint of the user is placed in an axial direction thereof.

Advantageous Effects

According to an embodiment of the present disclosure, a technical configuration including a support member, a first movement guiding shaft, an intermediate member, a second movement guiding shaft, a foot support, a first resistance force application part, and a second resistance force application part is provided, and it is possible to induce changes in the angle of the ankle normally generated during active walking for those who are unable to smoothly generate ankle movements necessary for walking due to lower limb paralysis or muscle weakness, and also enhance ankle muscle strength by applying a resistance force to the ankle movements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view schematically showing an ankle muscle resistance-training apparatus according to an embodiment of the present disclosure.

FIG. **2** is a cross-sectional view of the ankle muscle resistance-training apparatus of FIG. **1** taken along line II-II.

FIG. **3** is a rear view showing the ankle muscle resistance-training apparatus of FIG. **1**.

FIG. **4** is a view schematically showing an example of a first brake of a first resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**.

FIG. **5** is a view schematically showing another example of a first brake of a first resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**.

FIG. **6** is a block diagram schematically showing the first brake and a first adjustment switch.

FIG. **7** is a view schematically showing a linked state of a second resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**.

FIG. **8** is a block diagram schematically showing second and third brakes and a second adjustment switch.

BEST MODE

Hereinafter, preferred embodiments of the present disclosure will be described in detail with reference to the accompanying drawings, which will be readily apparent to those skilled in the art to which the present disclosure pertains. However, the description proposed herein is just a preferable example for the purpose of illustrations only, and not intended to limit the scope of the invention, so it should be understood that other equivalents and modifications could be made thereto without departing from the scope of the invention.

FIG. **1** is a perspective view schematically showing an ankle muscle resistance-training apparatus according to an embodiment of the present disclosure, FIG. **2** is a cross-sectional view of the ankle muscle resistance-training apparatus of FIG. **1** taken along line II-II, and FIG. **3** is a rear view showing the ankle muscle resistance-training apparatus of FIG. **1**.

FIG. **4** is a view schematically showing an example of a first brake of a first resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**, FIG. **5** is a view schematically showing another example of a first brake of a first resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**, and FIG. **6** is a block diagram schematically showing the first brake and a first adjustment switch.

FIG. **7** is a view schematically showing a linked state of a second resistance force application part of the ankle muscle resistance-training apparatus of FIG. **1**, and FIG. **8** is a block diagram schematically showing second and third brakes and a second adjustment switch.

As shown in FIGS. **1** to **8**, the ankle muscle resistance-training apparatus **100** according to an embodiment of the present disclosure includes a support member **110**, a first movement guiding shaft **120**, an intermediate member **130**, a second movement guiding shaft **140**, a foot support **150**, a first resistance force application part **170**, and a second resistance force application part **180**. Hereinafter, each of the components will be described in detail with continued reference to FIGS. **1** to **10**.

The support member **110** forms a framework of the ankle muscle resistance-training apparatus **100** according to the present disclosure, in which a lower portion is designed so as to be placed on a flat surface such as the ground (see **10** in FIG. **2**), and upwardly protruding at both side portions thereof, as shown in FIGS. **1** to **3**.

The first movement guiding shaft **120** serves as a hinge of the intermediate member **130** such that the intermediate member **130** is rotated with respect to the support member **110**, and as shown in FIG. **1**, may be positioned perpendicularly to the front-rear direction of the support member **110**, and, as shown in FIGS. **1** and **2**, positioned horizontally with respect to the ground (see **10** in FIG. **2**). Therefore, the intermediate member **130** may perform a pitch motion with respect to the first movement guiding shaft **120**.

In particular, the first movement guiding shaft **120** may be provided such that the ankle joint of the user is positioned in the axial direction thereof.

Accordingly, when the foot of the user is placed on the foot support **150** provided in the intermediate member **130** and rotated with respect to the first movement guiding shaft **120**, the foot may be rotated upward (dorsiflexion) or downward (plantarflexion) with respect to the ankle joint, and accordingly, it is possible to assist rehabilitation of those who are unable to smoothly generate the ankle movements necessary for walking due to lower limb paralysis or muscle weakness, by inducing normal angle changes of the ankle with respect to the ankle joint as are generated during walking.

The intermediate member **130** is provided between the support member **110** and the foot support **150** and supports the foot support **150**, in which, as shown in FIGS. **1** to **3**, the intermediate member **130** is rotatably provided on the support member **110** with respect to the first movement guiding shaft **120** so as to be rotated together with the first movement guiding shaft **120**, allowing a front portion of the foot to be rotated upward or downward with respect to the ankle joint.

The second movement guiding shaft **140** serves as a hinge of the foot support **150** such that the foot support **150** is rotated with respect to the intermediate member **130**, and as shown in FIG. **2**, may be positioned in parallel to the front-rear direction of the intermediate member **130** and positioned with an inclination with respect to the ground **10**. Therefore, the intermediate member **130** may approximately perform a roll motion with respect to the first movement guiding shaft **120**.

In particular, the second movement guiding shaft **140** may be provided such that the subtalar joint of the user is positioned in the axial direction thereof.

Accordingly, when the foot of the user is placed on the foot support **150** and rotated with respect to the second movement guiding shaft **140**, the foot may be rotated left or right with respect to the subtalar joint, and accordingly, it is possible to assist rehabilitation of those who are unable to smoothly generate the ankle movements necessary for walking due to lower limb paralysis or muscle weakness by inducing normal angle changes of the ankle with respect to the subtalar joint as are generated during walking.

The foot support **150** is where the foot of the user is placed, and, as shown in FIG. **2**, may be rotatably provided on the intermediate member **130** with respect to the second movement guiding shaft **140** and provided with an inclination with respect to the second movement guiding shaft **140**.

In particular, as shown in FIG. **3**, the second movement guiding shaft **140** may form an acute angle (θ**1**) with the ground **10** toward the front direction of the intermediate member **130**, and the foot support may form an obtuse angle (θ**2**) with the second movement guiding shaft **140** toward the front direction of the intermediate member **130**. Accordingly, through such inclined structures of the foot support **150** and the second movement guiding shaft **140**, the subtalar joint of the foot of the user may be positioned in the axial direction of the second movement guiding shaft **140**.

Furthermore, since the subtalar joint is positioned in the axial direction of the second movement guiding shaft **140**, when the second movement guiding shaft **140** is rotated, the front end of the foot support **150** may be moved while following a left-and-right trajectory (T in FIG. **1**). Specifically, the left-and-right trajectory T may be the trajectory in concave shape that gradually increases in height from its center towards the left and right sides. Therefore, it is possible to assist rehabilitation of those who are unable to smoothly generate the ankle movements necessary for walking due to lower limb paralysis or muscle weakness by inducing more stable angle changes of the ankle with respect to the subtalar joint as are generated during walking.

In addition, the ankle muscle resistance-training apparatus **100** according to the embodiment of the present disclosure described above may further include a left and right guide portion **160**, as shown in FIG. **1**.

The left and right guide portion **160** is a component that guides a front end of the foot support **150** in accordance with the left-and-right trajectory T while supporting the front end of the foot support **150**. For example, the left and right guide portion **160** may include a driven guide member **161** and a driving guide member **162** as shown in FIG. **1**. The driven guide member **161** is provided at a front end of the intermediate member **130** and has a concave shape corresponding to the left-and-right trajectory T, and the driving guide member **162** is provided to protrude from the front end of the foot support **150** and is moved while following the left-and-right trajectory T along the driven guide member **161**.

Therefore, since a rear end of the foot support **150** is provided on the intermediate member **130** through the second movement guiding shaft **140**, and the front end of the foot support **150** is supported by the intermediate member **130** through the left and right guide portion **160**, the foot support **150** is supported at both the front end and the rear end thereof, such that the left and right movements of the foot support **150** can be more stably guided with a minimum operation error.

The first resistance force application part **170** is a component for improving the muscle strength of the ankle joint of the user by applying a load while the user is placing his or her foot on the foot support **150** and actively moving the ankle joint, and as shown in FIGS. **1** and **3**, may be linked with the first movement guiding shaft **120** and apply a resistance force of an adjustable intensity against the active ankle movement of the user made with respect to the first movement guiding shaft **120**.

For example, as shown in FIGS. **1** and **6**, the first resistance force application part **170** may include a link shaft **171**, a rotating disk **172**, a first brake **173**, and a first adjustment switch **174**. The link shaft **171** may be rotatably provided on the support member **110** and linked with the first movement guiding shaft **120** through a first power transmission unit D**10**, and the rotating disk **172** may be rotatably provided on the support member **110** through a first support bracket **111** and linked with the first link shaft **171** through a second power transmission unit D**20**. The first brake **173** may apply a braking force to the rotating disk **172** using an electromagnet, and the first adjustment switch **174** may adjust the strength of the electromagnet of the first brake **173**.

As shown in FIGS. **1** and **3**, the first power transmission unit D**10** may include a first pulley D**11** provided on the first movement guiding shaft **120**, a second pulley D**12** provided on the link shaft **171**, and a first belt D**13** connecting the first and second pulleys D**11** and D**12**. As another example, although not shown, the first power transmission unit may have a sprocket-chain structure, or a gear assembly structure in which a plurality of gears are engaged.

In addition, as shown in FIG. **1**, the second power transmission unit D**20** may include a third pulley D**21** provided on the link shaft **171**, a fourth pulley D**22** provided on an outer peripheral surface of the rotating disk **172**, and a second belt D**23** connecting the third and fourth pulleys D**21** and D**22**. As another example, although not shown, the second power transmission unit may have a sprocket-chain structure, or a gear assembly structure in which a plurality of gears are engaged.

In addition, as shown in FIG. **1**, an one-way bearing **175** may be provided between the link shaft **171** and the third pulley D**21** such that resistance force is applied only when the foot support **150** is pressed with the ankle of the user. As another example, although not shown, such an one-way bearing may be provided between the first movement guiding shaft **120** and the first pulley D**11**, and provided between the rotating disk **172** and a shaft of the first support bracket **111**.

In addition, as shown in FIGS. **1** and **4**, the first brake **173** may be provided on the support member **110** through a second support bracket (**112** of FIG. **1**), and it may be a first eddy current brake **173***a* that applies magnetic force of different polarities to the rotating disk **172** disposed therebetween. In this case, the rotating disk **172** may be formed of a conductive material such as aluminum such that the eddy current can be induced in the rotating disk **172** according to the relative motion between the first eddy current brake **173***a* and the electromagnet. Accordingly, the intensity of the resistance force applied to the first movement guiding shaft **120** may be adjusted by adjusting the strength of the electromagnet of the first eddy current brake **173***a* through the first adjustment switch **174** formed of a variable resistor or the like.

As another example, as shown in FIG. **5**, the first brake **273** may include an electromagnet **273***a* provided in the second support bracket (see **112** in FIG. **1**) and a plurality of permanent magnets **273***b* arranged on the rotating disk **172** to correspond to the electromagnet **273***a* and having different polarity from the electromagnet **273***a*. Accordingly, the intensity of the resistance force applied to the first movement guiding shaft **120** may be adjusted by adjusting the strength of the electromagnet **273***a* through the first adjustment switch **174** formed of a variable resistor or the like.

The second resistance force application part **180** is a component for improving the muscle strength of the subtalar joint of the user by applying a load while the user is placing his or her foot on the foot support **150** and actively moving the subtalar joint, and as shown in FIGS. **3** and **7**, may be linked with the second movement guiding shaft **140** and apply a resistance force of an adjustable intensity against the active ankle movement of the user made with respect to the second movement guiding shaft **140**.

For example, as shown in FIGS. **3**, **7**, and **8**, the second resistance force application part **180** may include a center crank wheel **181**, a first side crank wheel **182**, a first horizontal sliding joint J**10**, a first crank arm **183***a*, a second crank arm **183***b*, a second brake **184**, and a second adjustment switch **185**. The center crank wheel **181** may be coupled to and linked with the second movement guiding shaft **140**, and the first side crank wheel **182** may be spaced apart from one side of the center crank wheel **181** and rotatably provided on one side of the intermediate member **130**, and the first horizontal sliding joint J**10** may be slidably provided on the intermediate member **130** so as to be slid left and right between the center crank wheel **181** and the first side crank wheel **182**. The first crank arm **183***a* may link the center crank wheel **181** with the first horizontal sliding joint J**10**, and the second crank arm **183***b* may link the first horizontal sliding joint J**10** with the first side crank wheel **182**. The second brake **184** may apply a braking force to the first side crank wheel **182** using an electromagnet, and the second adjustment switch **185** may adjust the strength of the second brake **184**.

Furthermore, the second brake **184** may take any of the two embodiments described above with respect to the first brake **173**, and since these two embodiments have been described above, the detailed description thereof will be omitted. Note that, among the two embodiments described above, when the first eddy current brake (see **173** of FIG. **4**) is employed as the second brake **184**, the first side crank wheel **182** may be formed of a conductive material such as aluminum. Accordingly, the intensity of the resistance force applied to the second movement guiding shaft **140** may be adjusted by adjusting the strength of the electromagnet of the second brake **184** through the second adjustment switch **185** formed of a variable resistor or the like.

In addition, as shown in FIGS. **3**, **7**, and **8**, the second resistance force application part **180** may further include a second side crank wheel **186**, a second horizontal sliding joint J**20**, a third crank arm **187***a*, a fourth crank arm **187***b*, and a third brake **188** for balance of the force applied to the second movement guiding shaft **120** directions through first and second horizontal sliding joints J**10** and J**20** and four crank arms **183***a*, **183***b*, **187***a*, and **187***b*. In addition, as shown in FIG. **7**, the first side crank wheel **182** may be continuously rotated in a first direction, and the second side crank wheel **186** may be continuously rotated in a second direction opposite to the first direction.

The second side crank wheel **186** may be spaced apart from the other side of the center crank wheel **181** and rotatably provided on the other side of the intermediate member **130**, and the second horizontal sliding joint J**20** may be slidably provided on the intermediate member **130** so as to be slid left and right between the center crank wheel **181** and the second side crank wheel **162**. The third crank arm **187***a* may link the center crank wheel **181** with the second horizontal sliding joint J**20**, and the fourth crank arm **187***b* may link the second horizontal sliding joint J**20** with the second side crank wheel **186**. The third brake **188** may apply a braking force to the second side crank wheel **186** using an electromagnet, and in particular, may be adjusted to the same strength as the second brake **184** described above by the second adjustment switch **185** described above for balance of the left and right forces. In addition, as shown in FIG. **7**, the first and second side crank wheels **182** and **186** may maintain the balance of left and right moments while being rotated in opposite directions through first and second horizontal sliding joints J**10** and J**20** and four crank arms **183***a*, **183***b*, **187***a*, and **187***b*. In addition, as shown in FIG. **7**, the first side crank wheel **182** may be continuously rotated in a first direction, and the second side crank wheel **186** may be continuously rotated in a second direction opposite to the first direction.

Furthermore, the third brake **188** may take any of the two embodiments described above with respect to the first brake **173**, and since these two embodiments have been described above, the detailed description thereof will be omitted. Note that, among the two embodiments described above, when the first eddy current brake (see **173** of FIG. **4**) is employed as the third brake **188**, the second side crank wheel **186** may be formed of a conductive material such as aluminum. Accordingly, the intensity of the resistance force applied to the second movement guiding shaft **140** may be adjusted by adjusting the strength of the electromagnet of the third brake **188** through the second adjustment switch **185** formed of a variable resistor or the like.

What is claimed is:

1. An ankle muscle resistance-training apparatus, comprising:
- a support member;
- a first movement guiding shaft perpendicular to a front-rear direction of the support member and horizontal to a ground;
- an intermediate member rotatably provided on the support member with respect to the first movement guiding shaft;
- a second movement guiding shaft perpendicular to the first movement guiding shaft and inclined to the ground;
- a foot support rotatably provided on the intermediate member with respect to the second movement guiding shaft and inclined with respect to the second movement guiding shaft, and configured to receive a foot of a user;
- a first resistance force application part linked with the first movement guiding shaft and applying a resistance force of adjustable intensity against the active ankle movement of the user made with respect to the first movement guiding shaft in a state in which the foot is placed on the foot support; and
- a second resistance force application part linked with the second movement guiding shaft and applying a resistance force of adjustable intensity against the active ankle movement of the user made with respect to the second movement guiding shaft in a state in which the foot is placed on the foot support,
- wherein the second resistance force application part includes:
  - a center crank wheel linked with the second movement guiding shaft;
  - a first side crank wheel spaced apart from one side of the center crank wheel and rotatably provided on one side of the intermediate member;

a first horizontal sliding joint slidably provided on the intermediate member to be slid left and right between the center crank wheel and the first side crank wheel;

a first crank arm linking the center crank wheel with the first horizontal sliding joint;

a second crank arm linking the first horizontal sliding joint and the first side crank wheel;

a second brake applying braking force to the first side crank wheel using an electromagnet; and

a second adjustment switch configured to adjust a strength of the second brake.

2. The ankle muscle resistance-training apparatus according to claim **1**,

wherein the first resistance force application part includes:

a link shaft provided rotatably on the support member and linked with the first movement guiding shaft;

a rotating disk, formed of a conductive material, that is rotatably provided on the support member through a first support bracket and is linked with the link shaft;

a first brake applying a braking force to the rotating disk using an electromagnet; and

a first adjustment switch configured to adjust a strength of the electromagnet of the first brake.

3. The ankle muscle resistance-training apparatus according to claim **2**,

wherein the first resistance force application part further includes a one-way bearing supporting any one of the first movement guiding shaft, the link shaft, and the rotating disk such that the resistance force is applied only when the foot support is pressed by an ankle of the user.

4. The ankle muscle resistance-training apparatus according to claim **1**,

wherein the second resistance force application part includes:

a second side crank wheel spaced apart from the other side of the center crank wheel and rotatably provided on the other side of the intermediate member;

a second horizontal sliding joint slidably provided on the intermediate member to be slid left and right between the center crank wheel and the second side crank wheel;

a third crank arm linking the center crank wheel with the second horizontal sliding joint;

a fourth crank arm linking the second horizontal sliding joint with the second side crank wheel; and

a third brake applying a braking force to the second side crank wheel using an electromagnet,

wherein the second adjustment switch is configured to adjust the strengths of the electromagnets of the second and third brakes together.

5. The ankle muscle resistance-training apparatus according to claim **1**,

wherein the first movement guiding shaft is configured to position an ankle joint of a user in an axial direction thereof.

6. The ankle muscle resistance-training apparatus according to claim **1**,

wherein the second movement guiding shaft is configured to position a subtalar joint of a user in an axial direction thereof.

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